Skilled Metro Workers Get Highest Payoffs for Using a Computer at Work

Lorin D. **Kusmin**

Workers who use computers on the job receive higher wages, reflecting computer-specific skills as well as broader skills. Even after taking into account differences in personal and job characteristics, industry, and occupational skill levels, there is still a 10-percent premium for use of a computer on the job. This accounts for a small portion of the metro-nonmetro wage gap, since computer use is more common in metro areas. The payoff to using a computer on the job is higher for college graduates and for workers with more experience, suggesting that computer skills may be of limited use to those who are otherwise disadvantaged in the labor market. Furthermore, this premium is only about 5 percent in nonmetro areas, while it is more than 12 percent in metro areas, suggesting that computer training will be of limited benefit to rural residents unless they are prepared to move to urban areas.

Average wages in nonmetro areas are much lower than in metro areas. In 1997, average weekly earnings for nonmetro wage and salary workers were 79 percent of the metro average. This difference is longstanding, and is not fully explained by metro/nonmetro differences in educational level; indeed, the wage gap is greater for workers with higher levels of education (McGranahan and Ghelfi). Metro and nonmetro workers differ in another respect: on-the-job computer use is more common in metro areas than in nonmetro areas (Kusmin). Previous research has indicated that workers who use computers on the job receive higher wages, and that this may help to explain changes in the wage distribution (Krueger). Are there links among these findings? Do differences in on-the-job computer use partly explain the current magnitude of the metro-nonmetro wage gap?

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Metro Area Residents Are More Likely To Use a Computer at Work

The share of employed adults using computers at work nearly doubled between 1984 and 1993. The proportion of jobs involving computer use was higher in metro areas in both years, and the absolute size of the gap has grown slightly over time. In 1984, 18 percent of nonmetro and 28 percent of metro workers used computers on the job; by 1993, 36 percent of nonmetro and 49 percent of metro workers did (fig. 1).

About two-thirds of this gap can be accounted for by metro-nonmetro differences in occupational mix and educational level (table 1). In particular, the concentration of managerial, professional, technical, and clerical workers in metro areas—as well as the larger proportion of college graduates—explains much of the gap in computer use. The growth in this gap between 1984 and 1993 reflects more rapid increases in computer use by occupational, industrial, and educational groups that tend toward urban areas. It also reflects, to a lesser extent, changes in the occupational composition of the urban and rural workforces.

Computer Users Earn More

Computer users earn far more than other workers; the difference in average wages between the two groups is 35 percent in nonmetro areas and 43 percent in metro areas (table 2). Of course, earnings are higher in metro areas for computer users and nonusers alike, so differences in computer use are not the main source of metro-nonmetro wage differences.

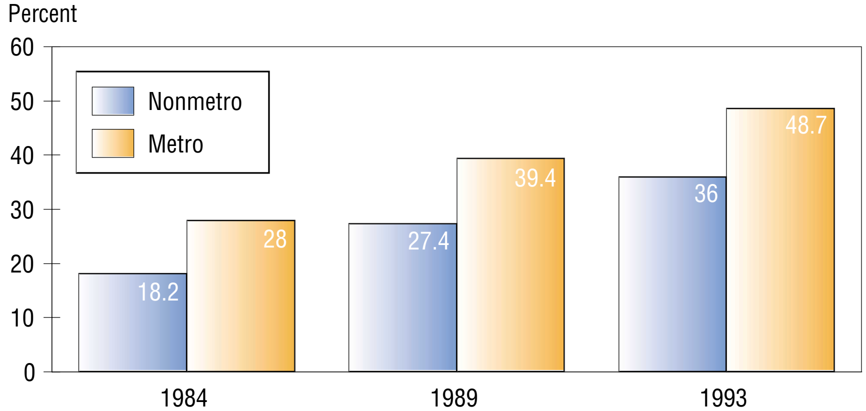
But when personal (sex, marital status, veteran status, race and ethnicity, region, metro/nonmetro residence, labor force experience, and education) and job characteristics (unionized, full- or part-time) are taken into account, a somewhat different picture emerges. Computer use on the job now raises hourly earnings by about 22 percent, still considerable but smaller than with the simple (unadjusted) comparison (fig. 2).

A similar analysis finds that the metro-nonmetro difference in wages is about 17 percent when on-the-job computer use is left out of the model, and about 15 percent when it is taken into account. This suggests that computer use on the job explains only a small portion of metro/nonmetro wage differences. This analysis assumes that the returns to computer use are the same for all workers.

Figure 1

Percentage using computers at work, metro and nonmetro areas, 1984-93

The percentage of the workforce using computers on the job has remained higher in metro areas



Source: Calculated by ERS from Current Population Survey, October 1984, October 1989, and October 1993.

Computer Payoff Is Smaller When Industry and Occupation Are Considered

Is the wage premium for workers using computers on the job actually a payoff to computer-specific skills, or is it due to other factors? It might be explained by higher wages in those occupations or industries where computer use is more common. Or use of a computer on the job may be a proxy for broader capabilities—perhaps cognitive skills, detail orientation, or a willingness to learn—that are rewarded by the labor market. Including measures of industry, occupation, and skill level in our model should allow us to test these possibilities.

The estimated computer wage premium falls from 22 to 18 percent when industry effects are taken into account (fig. 2). When we add controls for eight occupational groups in the wage model, the wage premium falls further to 14 percent. However, this approach may underestimate the return to computer skills since possession of these skills admits individuals to higher paying industries.

To better determine whether computer use is serving as a proxy for other work skills, we used the Department of Labor's Dictionary of Occupational Titles (DOT) data file to compute approximate skill levels for individual occupations along several dimensions (see

Table 1

Components of metro-nonmetro gap in computer use at work, 1993

Most of the gap in computer use is accounted for by differences in occupation or educational level

Item	Computer use gap	Share of total gap
	Percentage points	*Percent*
Gap accounted for by:		
Job characteristics	7.4	58
Occupational mix	5.8	46
Industrial mix	1.0	8
Other job characteristics	.6	5
Personal characteristics	1.9	15
Educational level	2.6	20
Racial/ethnic background	-.9	-7
Other personal characteristics	.2	2
Gap not accounted for:		
Effect of metro residence	3.2	25
Total metro-nonmetro gap	12.7	100

Note: Figures may not add to total due to rounding.
Source: Estimated by ERS using a linear probability regression model and data from the October 1993 Current Population Survey.

Table 2
Average hourly earnings by residence and on-the-job computer use, 1993
Average hourly earnings are higher for computer users in both metro and nonmetro areas

Item	Nonmetro	Metro	Metro-nonmetro difference
	Dollars		*Percent*
Don't use computer	9.01	10.51	16.6
Use computer	12.14	15.07	24.1
	Percent		
User-nonuser difference	34.7	43.4	NA

NA = Not applicable.
Source: Calculated by ERS from Current Population Survey, October 1993.

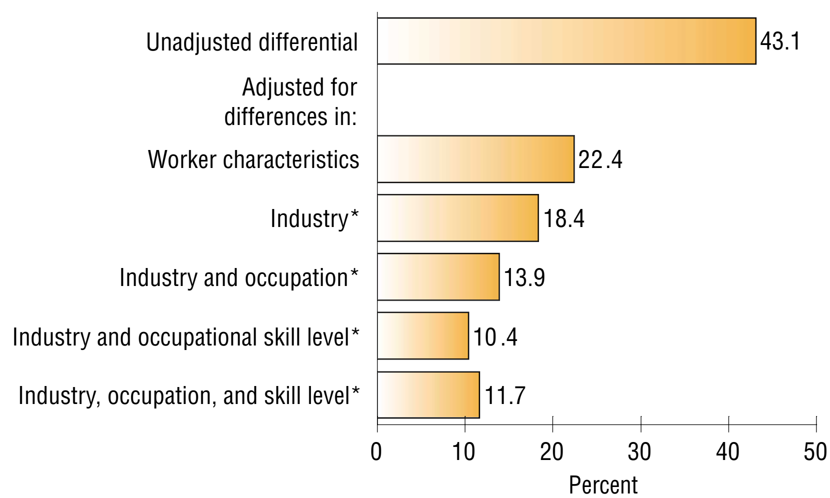
"Data, Methods, and Definitions"). The four DOT occupational characteristics considered here are the "general educational development" levels of the job with respect to math, language skills, and general reasoning, and the extent of "specific vocational preparation" required for the job. When these measures are used instead of the eight occupational categories, the estimated wage effect of computer use falls from 14 to just over 10 percent (fig. 2). This suggests that some of the previously measured premium to direct computer use is actually a return to broader associated skills, although the effect of computer use effect remains statistically significant. If both occupational skill levels and broad occupational categories are taken into account, the estimated direct computer use premium is about 12 percent.

However, the demand for general skills cannot be neatly separated from the demand for computer skills in the labor market as a whole. The increasing need for individuals able to use computers will also raise the payoff to other skills and characteristics that are necessary for or even merely correlated with computer skills—such as mathematical and reasoning skills, education, and patience—even in those jobs that do not require computer use. The payoff to general skills may itself be influenced by the increasing role of computers in the workplace. Thus, the overall effect of the demand for computer skills on the relative wages of more skilled workers is understated if we look only at the individual return on computer skills.

Metro-Nonmetro Wage Gap Transcends Computer Use

Differences in computer use explain only about 4 percent of the overall metro-nonmetro wage gap (table 3). About 30 percent of the gap can be explained by differences in educational level and/or occupational skills, but two-thirds of the wage gap is unexplained by any of the variables in the model. The other variables account for little of the metro-nonmetro gap, either because their effects on wages are weak or because the average metro-nonmetro difference in these variables is small. Some of the wage gap may reflect cost-of-living differences between metro and nonmetro areas, but area-specific cost-of-living data that would allow us to quantify this are not available.

Figure 2
Wage premium for computer use, 1993
The wage premium persists when other job and worker differences are considered



*Includes worker characteristics.
Source: Calculated by ERS from Current Population Survey, October 1993.

Payoff for Computer Use Is Smaller in Nonmetro Areas

The premium for on-the-job computer use is much larger in metro areas—or, equivalently, the premium for metro residence is much larger for those who use a computer. After industrial mix and occupational skill levels are taken into account, the "unexplained" metro-nonmetro wage gap for those workers who do not use computers on the job is less than 11 percent, while the corresponding value for on-the-job computer users is 19 percent. As a result, while the estimated computer use wage premium is only about 5 percent in nonmetro areas, it is more than 12 percent in metro areas.

Thus, while lower rates of computer use in nonmetro areas account for relatively little of the metro-nonmetro wage gap, lower returns to computer use are a substantial component of that gap. In particular, the more than one-third of all nonmetro workers who use computers on the job appear to lose out on an additional wage premium of 8 percent they would have received in metro areas.

This last result is broadly consistent with past work at ERS (McGranahan and Ghelfi; McGranahan and Kassel, 1995) indicating that the payoff to higher levels of education is greater in metro than in nonmetro areas and that, at least until recently, those with higher skill levels were more likely to migrate to metro areas. So the skills gap and associated wage gap in rural areas seems to reflect weaker demand for skills in these areas, more so than any deficit in the supply of skills. Stronger demand for skills in urban areas, as expressed by greater wage premiums for those skills, encourages skilled workers to migrate, leaving lower average skill levels in the remaining rural population. Thus, average rural wages are lower than urban wages both because the average skill level of rural workers is lower and because the wage premium paid to remaining skilled workers is lower.

Computer Premium Varies With Worker and Job Characteristics

The personal monetary payoff to computer use is sensitive to several factors, including education, skills, union membership, race/ethnicity, and labor force experience. College graduates are more likely than high school graduates to have computer skills. If the demand for such skills were similar in the jobs held by high school graduates and college graduates, we would expect the payoff on those skills to be greater among high school graduates, because such skills are scarcer among them.

Instead we find that the return to computer use is about 10 percentage points higher for those with at least a college degree than for high school graduates. This suggests a higher demand for computer skills in the types of jobs filled by college-educated persons. Or else the types of computer skills sought in many college-educated workers (for example, programming skills or facility with complex accounting programs) are scarcer relative to demand than the skills associated with on-the-job computer use by high school graduates (for example, data entry or word processing).

On-the-job use of computers interacts strongly with specific vocational preparation in the wage model. Computer use appears more profitable in jobs with extensive vocational preparation, and equivalently, the return to this preparation is higher in jobs where a computer is used. In fact, the

Table 3

Factors accounting for metro-nonmetro wage gap

Differences in education, occupation, and computer use account for about one-third of the metro-nonmetro wage gap

Item	Wage difference	Share of total gap
	Percent	
Education	3.2	16.2
Occupational skill levels	2.7	13.7
Race and ethnicity	-.9	-4.4
Industry	-.05	-.2
Computer use	.8	4.2
Other[1]	.8	4.0
Total explained	6.7	33.5
Unexplained	13.3	66.5
Total metro-nonmetro gap	20.0	100.0

[1]Includes gender, marital status, union membership, veteran status, part-time status, labor force experience, and region.

Source: Calculated by ERS from Current Population Survey, October 1993.

Data, Methods, and Definitions

Data

Data for this analysis are from responses to the Current Population Survey (CPS). The CPS is conducted monthly by the Census Bureau to collect data on employment and unemployment. Data are collected from a sample of approximately 57,000 households, chosen to represent the civilian noninstitutional population of the United States.

Selected rounds of the CPS provide data on the use of computers. The data used here come primarily from the October 1993 CPS, which asked about computer use on the job, at home, and at school. The question most relevant to this article was "Does...directly use a computer at work?"

The sample used in this study includes respondents who were employed, who were asked about weekly earnings in the October survey (a quarter of all respondents are asked about earnings in any single month), and who responded to all of the questions that are used in the analysis, for a total of about 14,000 unweighted observations.

Methods—Explanation of Wage Differences

For this study, a series of conventional wage regression models was estimated, with on-the-job computer use and other variables used to explain wage differences. The specific variable being explained by these models was the logarithm of the hourly wage, or reported weekly earnings divided by usual hours worked. The decomposition of urban-rural wage differences into explained and unexplained components follows the model used in McGranahan and Kassel (1996). In that model, each explained component of the difference between the groups' wages corresponds to one of the variables in the wage model, and equals the coefficient on that variable in the wage model multiplied by the difference between the two group means for that variable. The unexplained component is the residual after all explained components have been subtracted from the overall wage difference between the two groups.

Definitions

Occupational Skill Levels

The Dictionary of Occupational Titles (DOT) file was used to assign skill levels to occupations. The DOT contains quantitative assessments of the characteristics of many narrowly defined occupations. In order to associate skill levels with individuals in the CPS data, these occupations had to be aggregated to correspond to the level of occupational detail available on the CPS. Because employment totals in DOT-level occupations were not readily available for weighting, equal weights were assigned to each DOT-level occupation in estimating the average characteristics of individual CPS-level occupations. This procedure could lead to overestimates or underestimates of the average skill levels for CPS-level occupations. However, for the skills considered in this study, the dispersion of skill level values among the various DOT-level occupations within a single CPS-level occupation was usually small relative to the dispersion among CPS-level occupations, so any misestimates are likely to be small.

returns to specific vocational preparation are more than three times as great when computer skills are used on the job.

The premium for computer use appears to be greater for racial and ethnic minorities. The estimated premiums are 6-8 percentage points higher for Blacks, Hispanics, and Asian-Americans than for non-Hispanic Whites. Worker experience is also a factor. The premium for computer use is relatively small for new workers, while it is much larger for those in their peak earning years.

Since metro jobs and workers are more likely to have characteristics associated with large premiums for computer use, these differences might have explained the apparent metro-nonmetro gap in the wage premium described earlier. However, this is not the case.

Computer Wage Premiums Reflect Both Computer-Specific Skills and Broader Skills

An area of some debate is whether the apparent return to computer use on the job reflects a return to specific computer skills or whether computer use is a proxy for other skills or job characteristics. An answer to this question would help to determine whether public expenditure on the development of computer skills per se is a good investment of education or job training funds.

Definitions (Cont.)

Metro and Nonmetro Areas

In this article, “metro” refers to metropolitan areas as designated by the Office of Management and Budget, while “nonmetro” refers to all other areas. The metro or nonmetro status of respondents is based on their place of residence, not their place of work. In 1990, 11.5 percent of workers living in nonmetro areas commuted to jobs in metro areas. For 1993, the metro-nonmetro designation of residence in the CPS was based on the 1980 Census of Population.

Labor Force Experience

Labor force experience (LFE) is not directly measured in the CPS. Thus, LFE (in years) has been estimated from the formula LFE = Age in Years - Estimated Years of Education - 6, where estimated years of education are derived from the highest level of education completed. The term LFE^2 is commonly included in wage regressions to capture the widely observed nonlinear relationship between experience and wages (on average, wages rise rapidly early in a working career, begin to level off, and may even decline near the end of working life).

Industry

A 22-industry breakdown of employment was used to estimate industry effects. The industries for which wage effects were estimated were agriculture; mining; construction; durable goods manufacturing; nondurable goods manufacturing; transportation; communications; utilities and sanitary services; wholesale trade; retail trade; finance, insurance, and real estate; private household services; business services; personal services; entertainment and recreation services; hospitals; medical services (except hospitals); education services, social services; professional services; forestry and fishing; and public administration. With retail trade treated as the base (omitted) category, the estimated wage differentials associated with these industries ranged from -13 percent for private household services to +61 percent for mining.

Occupation

A nine-occupation breakdown of employment was used to estimate occupational group effects. Wage effects were estimated for managers; professionals; technical occupations; sales occupations; clerical occupations; service occupations; craft occupations; operators; and laborers. With sales occupations treated as the base (omitted) category, the estimated wage differentials associated with these occupational groups ranged from -18 percent for laborers to +18 percent for professionals.

Our results suggest that the apparent payoff to on-the-job computer use reflects returns to both computer-specific skills and broader skills. Taking into account other skill measures as well as occupational and industry category variables, the estimated size of the computer wage premium is resduced by more than half, from 22 percent to 10 percent. However, the latter figure is still substantial and statistically significant.

Conclusions

Is computer use a factor in explaining the metro-nonmetro wage gap? Computer use on the job is higher in metro areas, partly due to differences in occupational mix and educational attainment between metro and nonmetro areas. This gap in use, combined with the computer wage premium, appears to explain a small percentage of the metro-nonmetro wage gap.

However, workers in nonmetro areas benefit less than metro workers from computer skills, since the premium paid for working with a computer appears to be substantially less outside of metro areas. This inequity persists even after other differences between metro and nonmetro workers are taken into account, and is consistent with past work indicating that the demand for worker skills is weaker in nonmetro areas. So, while training in computer skills may benefit nonmetro workers, they may have to relocate in order to obtain the most benefit from such training.

Photo courtesy PhotoDisc, Inc.

These conclusions may have to be modified as the economic significance of the Internet, not reflected in the data here, continues to explode. The Internet has likely increased the relevance of computer skills in many occupations. It may also lessen the importance of physical proximity to customers, clients, and information resources in some industries, allowing firms in relatively isolated areas to participate in the economy in ways that previously required location in metro areas. In turn, this may increase the demand for workers with computer skills and other skills in less densely settled areas.

The computer wage premium is greatest for workers who also have higher levels of education and/or specific training. Thus, computer skills may have limited value to those less-skilled workers who are often the focus of public policy.

For Further Reading . . .

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